POLLUTION CURBS, INC.

SCRUBBER SYSTEM

and

ODOR INTENSITY EVALUATION

301808

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Phone 612-647-0151

Contract #100020

November 13, 1970

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ODOR INTENSITY EVALUATION

Prepared for:

REILLY TAR and CHEMICAL CORPORATION

7200 Walker Avenue

St. Louis Park, Minnesota

Submitted by:

POLLUTION CURBS, INC.

Frank J. Belgea

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SUMMARY OF RESULTS

The operating parameters of the proto-type scrubber system are the following:

1. The volumetric gas flow rate of the system is 665 standard cubic feet per minute.
2. Static pressure drop across the scrubber is 4.8 inches of water. Pressure drop across the secondary condenser is 0.2 inches of water.
3. Ducts carrying effluent are 10 inch diameter iron pipe.
4. The fan is a New York Blower model 172 G.I. The outlet is baffled reducing the discharge opening from 0.633 square feet to 0.280 square feet.
5. Moisture content is 1.6 percent by weight.
6. The scrubber is operating with a water pressure of 6 pounds per square inch at the nozzle and a flow rate of 4 gallons per minute.

Odor strength is 2.8×10^{11} odor units per cubic foot at the scrubber inlet and 7.8×10^{8} odor units per cubic foot at the discharge.

Sulfur dioxide concentration at the inlet and outlet of the scrubber system is less than 1 part per million.

1.0 INTRODUCTION

1.1 A study was made of the proto-type scrubber system to provide basic engineering design data and to determine the sulfur dioxide and odor emissions of the system.

1.2 Two samples were obtained from each of three points in the system on October 29, 1970. The still charge number was OR 2829. Samples for odor analysis were taken the previous day also, but the run was subsequently aborted because of excessive water in the charge. These water cut samples were analyzed along with those taken during the first and fourth oil cuts and the results presented in Section 2.2.

2.0 RESULTS

2.1 Pertinent data and odor analysis results are presented as obtained at three points in the scrubber system. Point A is approximately 3 feet upstream from the secondary condenser. Point B is at the inlet to the scrubber. Point C is at the scrubber discharge approximately 4 feet upstream from the fan. A diagram is presented in Section 5.0. Sulfur dioxide concentration was found to be less than 1 part per million in all cases.

2.2 Water Cut. Still Charge No. OR 2828. Still Temperature 108°C.

Location	Point A	Point B	Point C
Duct Temperature	196°F.	176°F.	145°F.
Static Pressure	-0.2 in. w.c.	-0.4 in. w.c.	-4.8 in. w.c.
Moisture Content	35.1% by wt.		
Odor Strength	1.3×10^{12} Odor Units	2.8×10^{11} Odor Units	7.8×10^{8} Odor Units

2.3 First Oil Pan. Still Charge No. OR 2829. Still Temperature 220°C.

Duct Temperature	68°F.	63°F.	52°F.
Static Pressure	-0.2 in. w.c.	-0.4 in. w.c.	4.8 in. w.c.
Moisture Content	0.9% by wt.	0.9% by wt.	0.4% by wt.
Odor Strength	1.7×10^{9} Odor Units	5.4×10^{10} Odor Units	1.0×10^{7} Odor Units

2.4 Last Oil Pan. Still Charge OR 2829. Still Temperature 380°C.

Duct Temperature	180°F.	136°F.	96°F.
Static Pressure	-0.2 in. w.c.	-0.4 in. w.c.	-4.8 in. w.c.
Moisture Content	9.7% by wt.	2.7 by wt.	1.6% by wt.
Odor Strength	$2/3 \times 10^{4}$ Odor Units	4.8×10^{5} Odor Units	7.6×10^{3} Odor Uni

3.0 PROCEDURES

All methods and procedures are in accordance with industry accepted practices.

3.1 System volumes were determined by pitot traverse.

Percent moisture was measured psychrometrically.

Water pressure and flow rate were measured directly.

3.2 Sulfur dioxide concentration was measured by the Chemico® method as published in U.S. Department of Health, Education and Welfare, Public Health Service Publication No. 999-AP-13, 1965.

3.3 Odor Strength was evaluated by extracting gas from the stack and determining the dilution of that gas required for the panel members to detect no odor. The methods used were those of Benforado, Air Pollution Control Association, 61st Annual Meeting, 1961, and ASTM D-1391-57 (reaffirmed 1967). An odor unit is the number of cubic feet to which one cubic foot of odorus stack gas must be diluted to bring it to the odor threshold.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 There are presently no state or federal regulations restricting sulfur dioxide emissions. The City of St. Louis Park does restrict emissions which would cause the concentration in ambient air to reach .02 ppm at the property line. However, a stack concentration of less than 1 ppm would be diluted to a level much lower than this limitation in ambient air.

4.2 The odors emitted by the scrubber system are characteristic of organic sulfides and H_2S. These compounds have very low odor thresholds and are not ordinarily very soluble in water. Thermal oxidation is the most commonly practiced method of destroying these compounds. In some cases, organic sulfide and H_2S odors

have been successfully destroyed by chemical oxidation employing potassium permanganate in a wet scrubber. In any case, the system evaluated is capable of reducing the odor level 1000 fold. However, this reduced level of emissions still exceeds the allowable MPCA emissions level by a factor of 150 million.

4.3 The effectiveness of the proto-type scrubber can probably be improved by increasing the water pressure (presently 6 psi) and/or consumption (presently 4 gpm). It does not appear, however, that these changes would satisfy the regulatory agency. Spraying a permanganate solution will have a greater effect or improving performance. The extent and total satisfaction would be determined by odor evaluation.

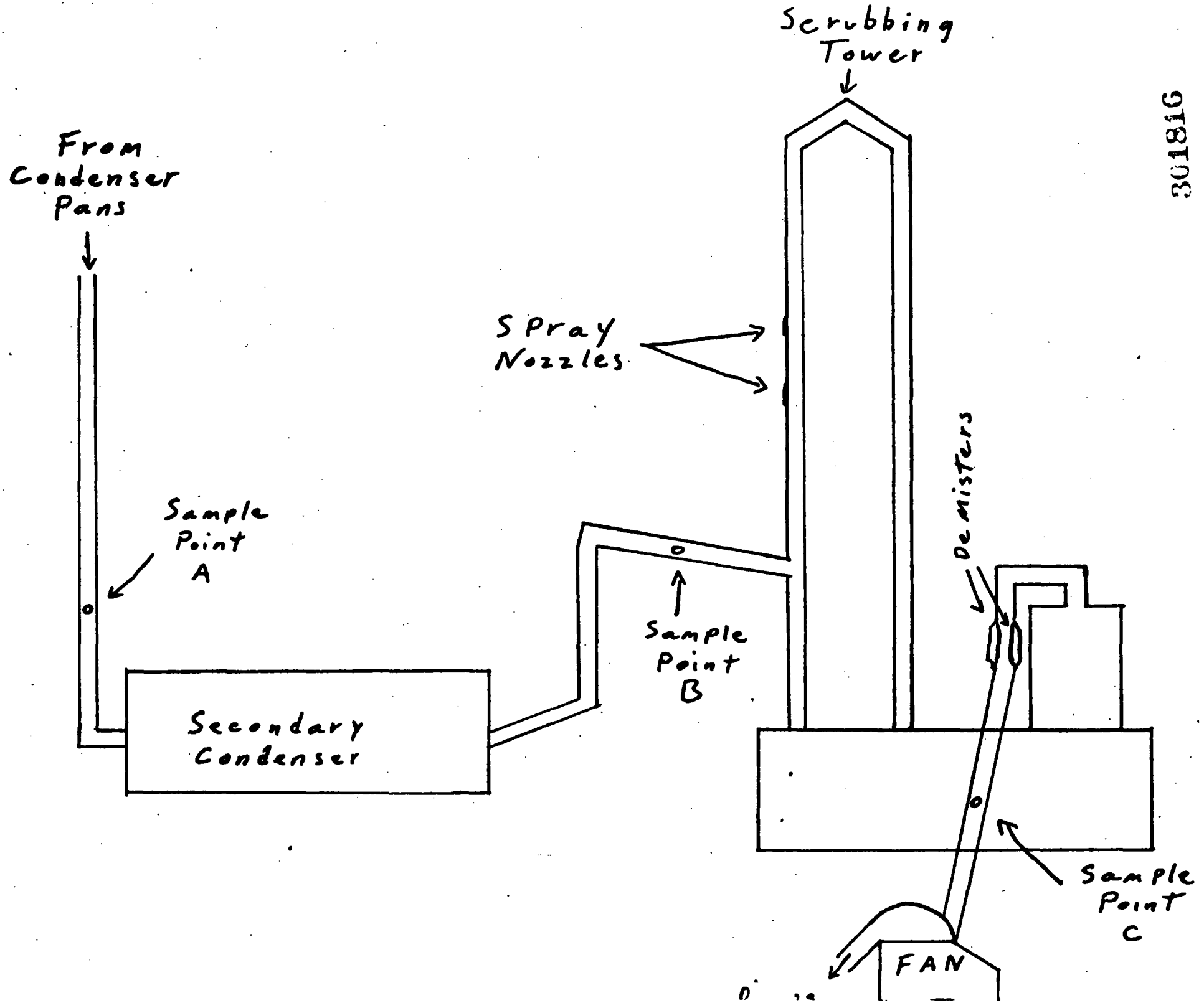
5.0 APPENDIX A

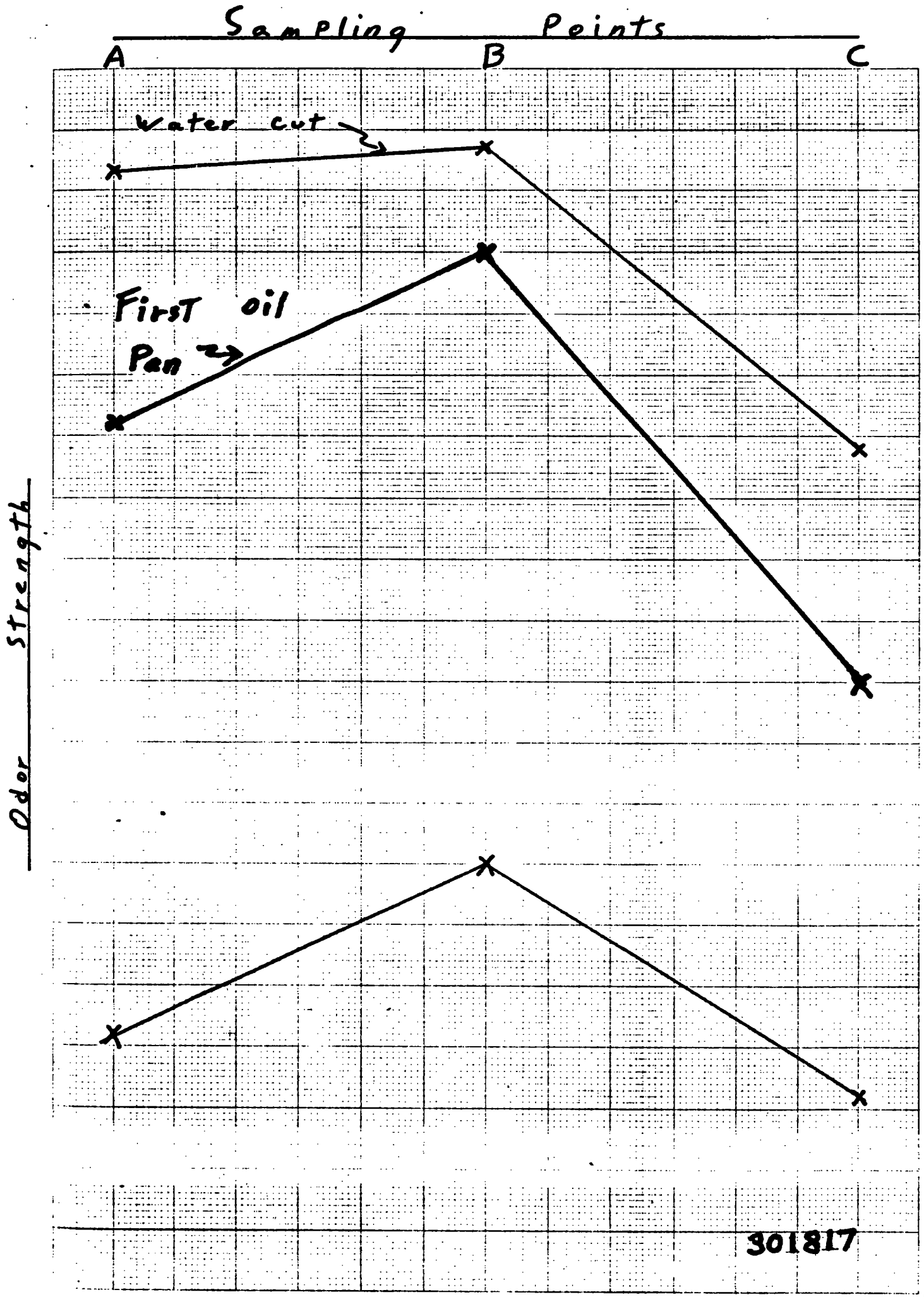
5.1 Diagram of Proto-type Scrubber Showing Sampling Points

5.2 Graphic Relationship of Odor Strength versus Location in System

6.0 APPENDIX B

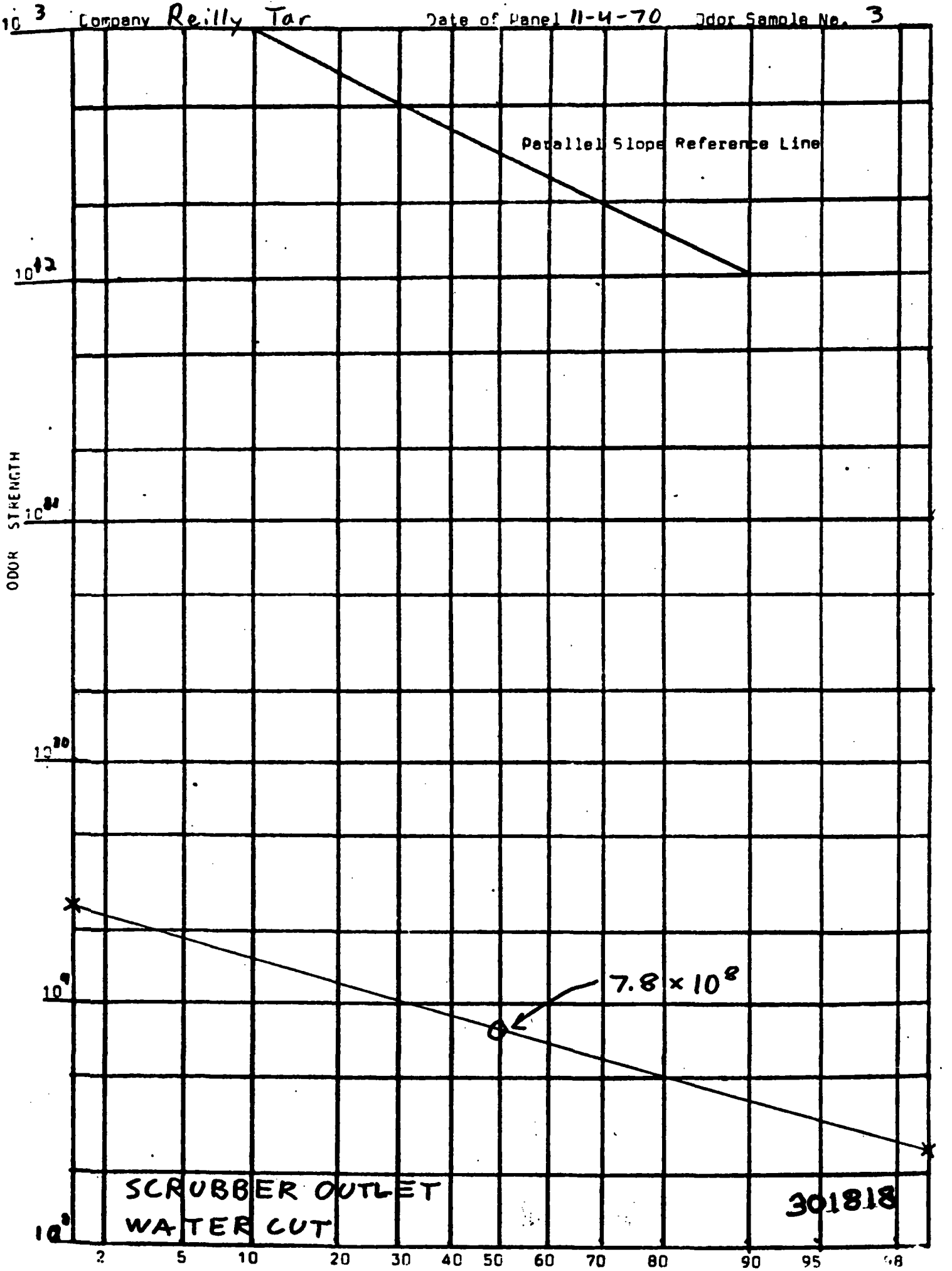
6.1 - 6.9 Odor Response Charts


Scrubbing Tower
From Condenser Pans
Spray Nozzles
Sample Point A
Sample Point B
Demisters
Secondary Condenser
Sample Point C
FAN


Sampling Points
A
B
C
Water cut
First oil
Pan
Odor Strength
301817

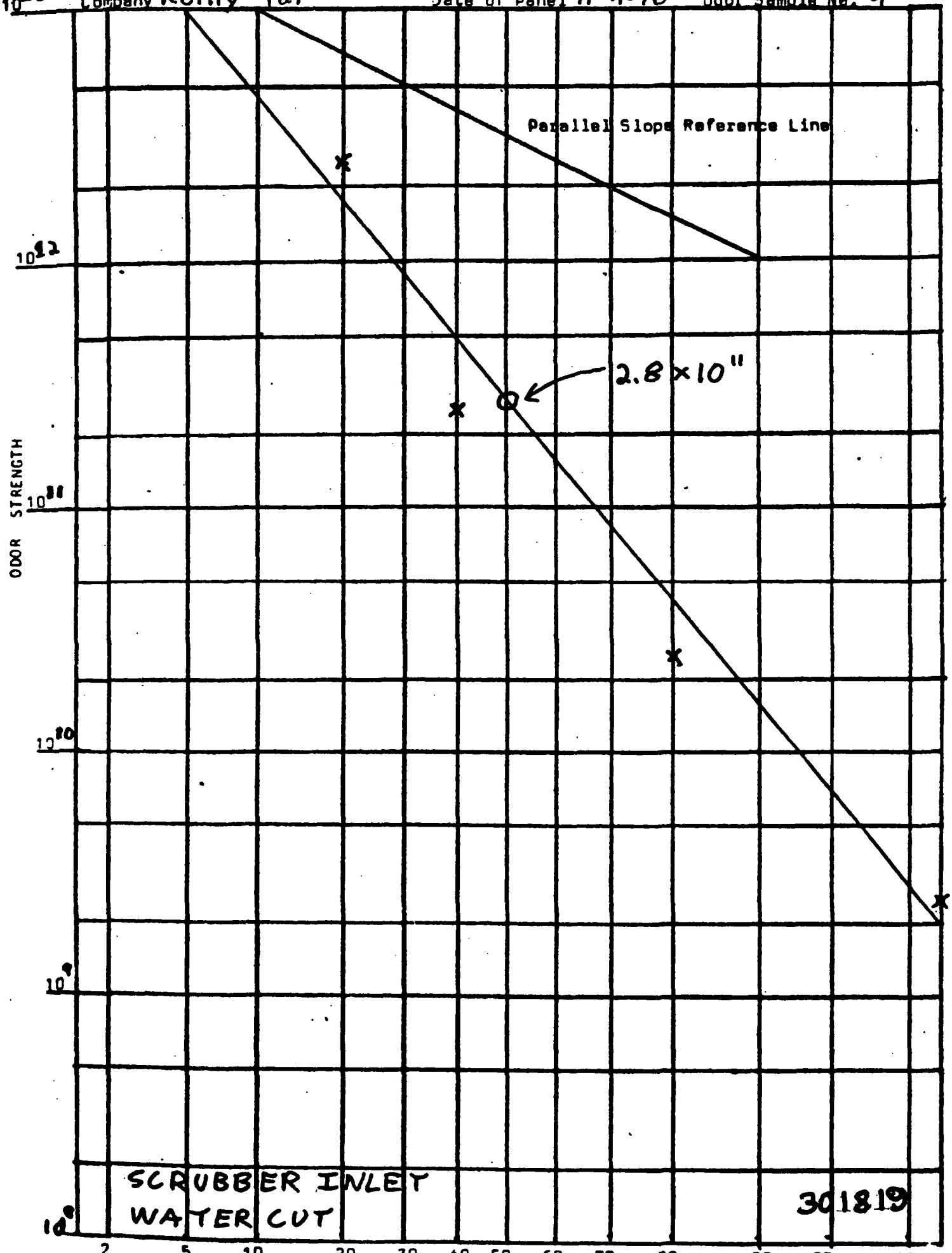
POLLUTION CURBS, INC. ODOR RESPONSE CHART NO. 11-7

Company Reilly Tar Date of Panel 11-4-70 Odor Sample No. 3



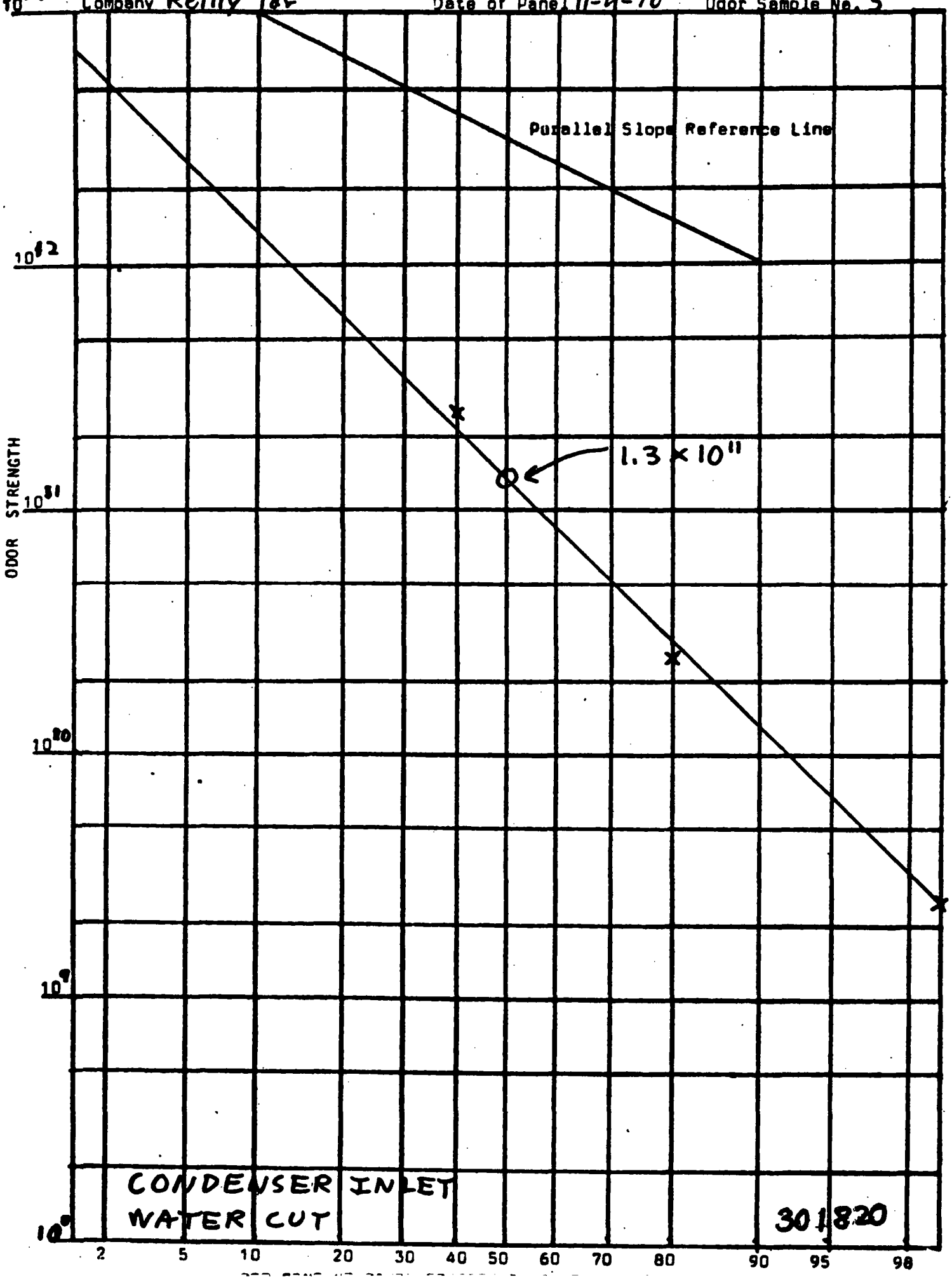
POLLUTION CURBS, INC. ODOR RESPONSE CHART NO. 11-8

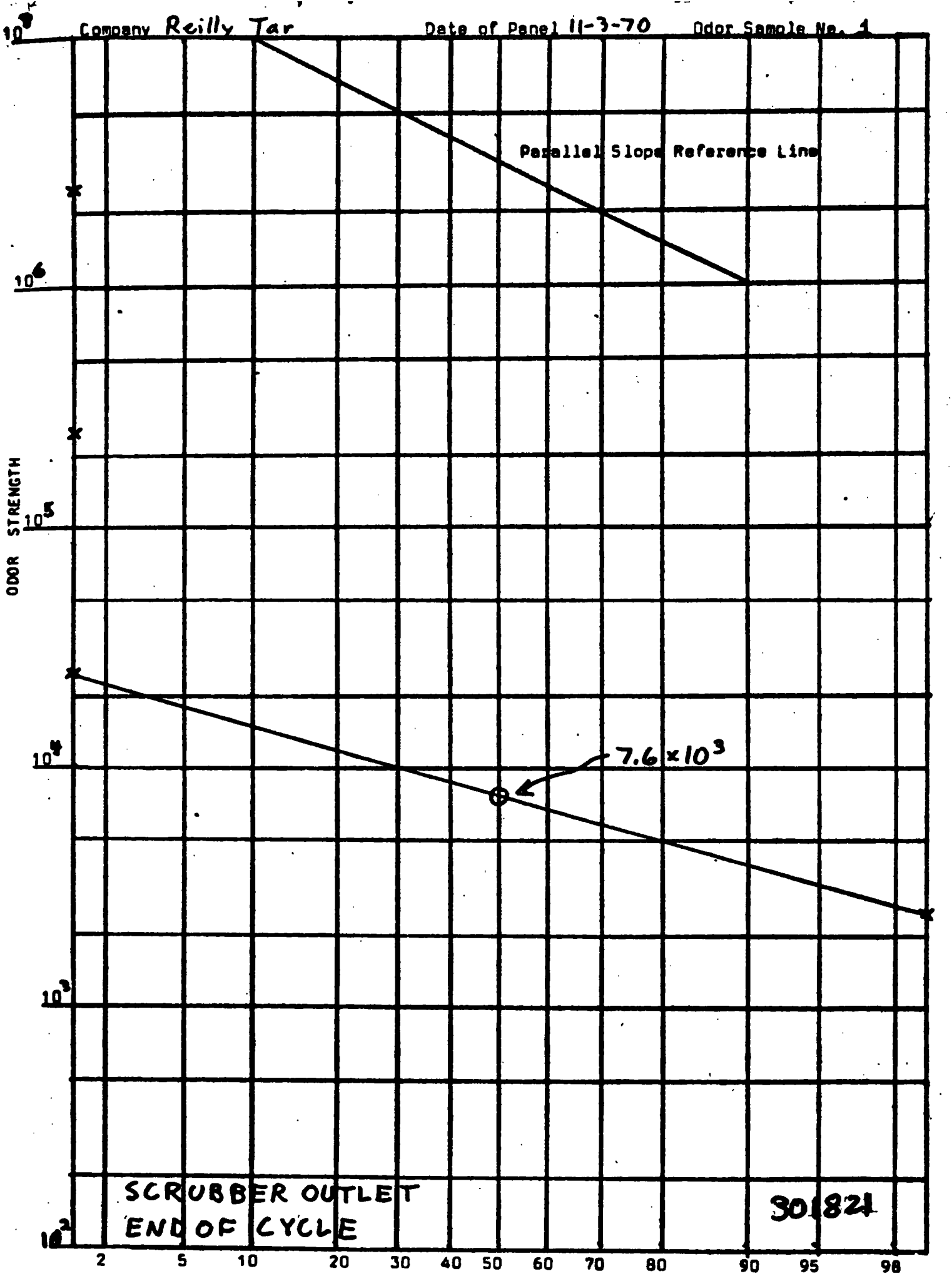
Company Reilly Tar Date of Panel 11-4-70 Odor Sample No. 4

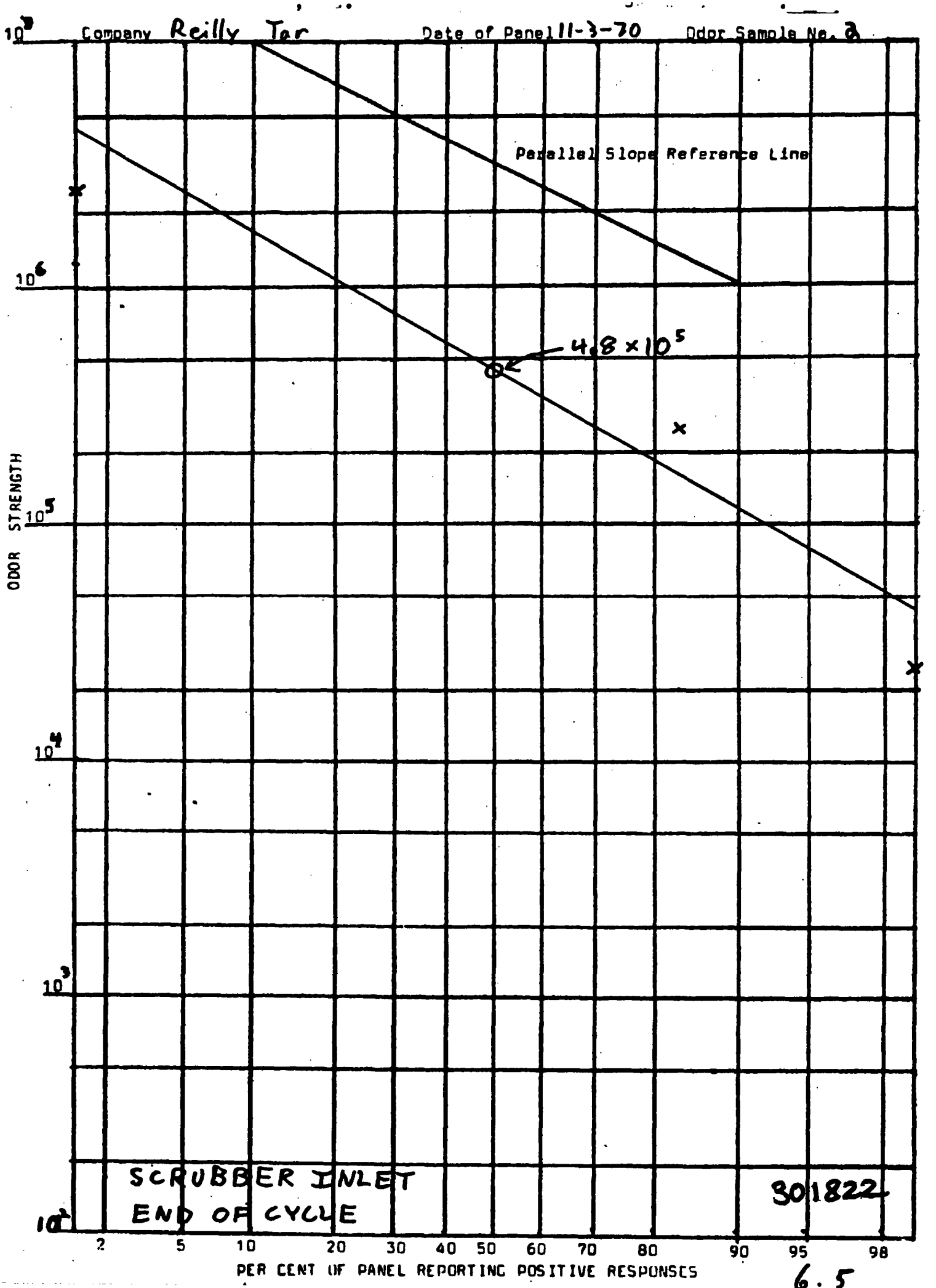


POLLUTION CURBS, INC. ODOR RESPONSE CHART NO. 11-9

Company Reilly Tar Date of Panel 11-4-70 Odor Sample No. 5

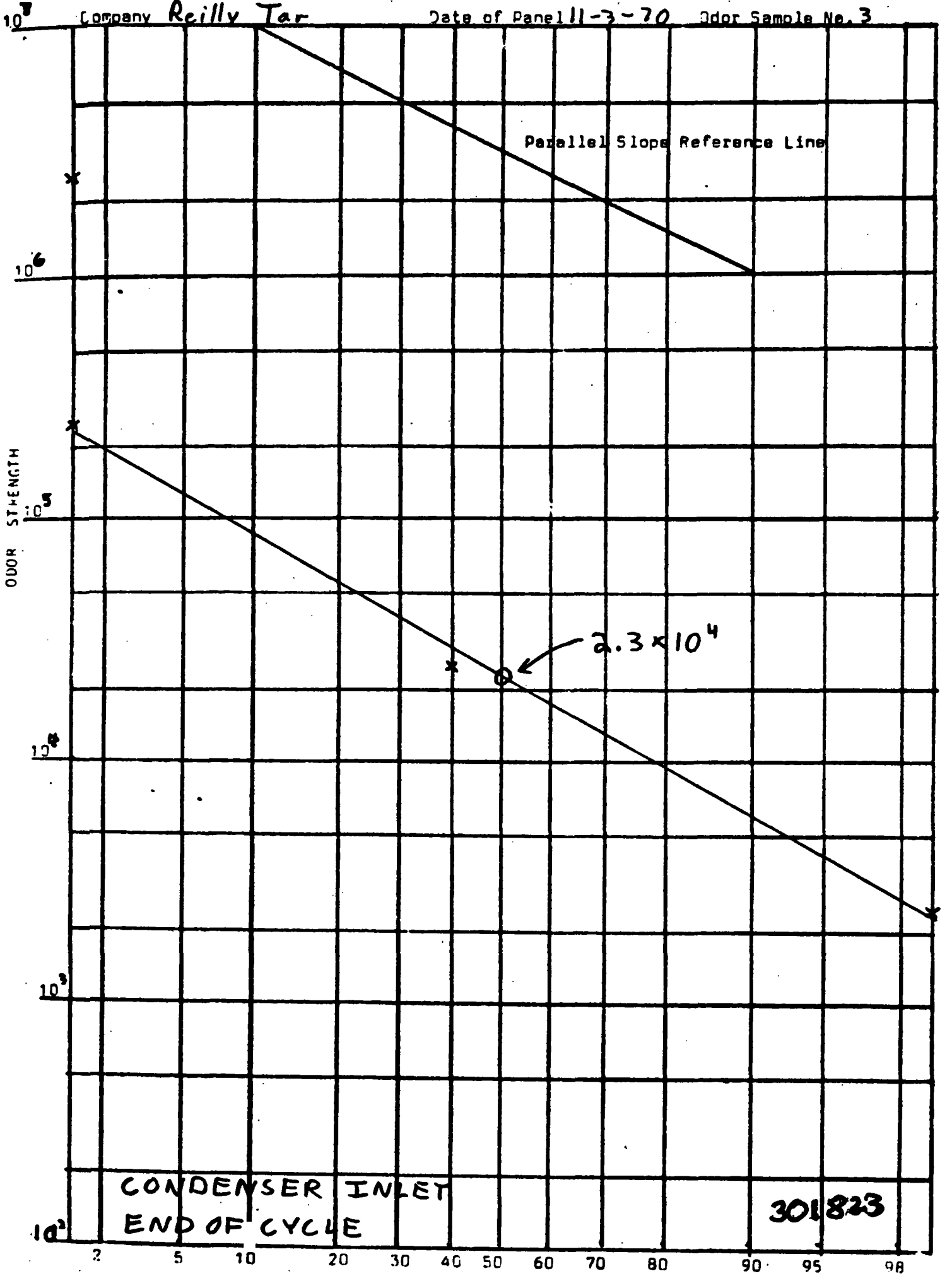



Company Reilly Tar
Date of Panel 11-3-70
Odor Sample No. 1
Parallel Slope Reference Line
7.6 x 10³
SCRUBBER OUTLET
END OF CYCLE
30821
ODOR STRENGTH
PER CENT OF PANEL REPORTING POSITIVE RESPONSES
10⁷
10⁶
10⁵
10⁴
10³
10²
2
5
10
20
30
40
50
60
70
80
90
95
98


Company Reilly Tar
Date of Panel 11-3-70
Odor Sample No. 3
Parallel Slope Reference Line
4.8 x 10^5
ODOR STRENGTH
10^7
10^6
10^5
10^4
10^3
10^2
SCRUBBER INLET
END OF CYCLE
301822
2
5
10
20
30
40
50
60
70
80
90
95
98
PER CENT OF PANEL REPORTING POSITIVE RESPONSES

D V CORBS, INC. ODOR RESPONSE CHART NO. 11-3

Company Reilly Tar Date of Panel 11-3-70 Odor Sample No. 3



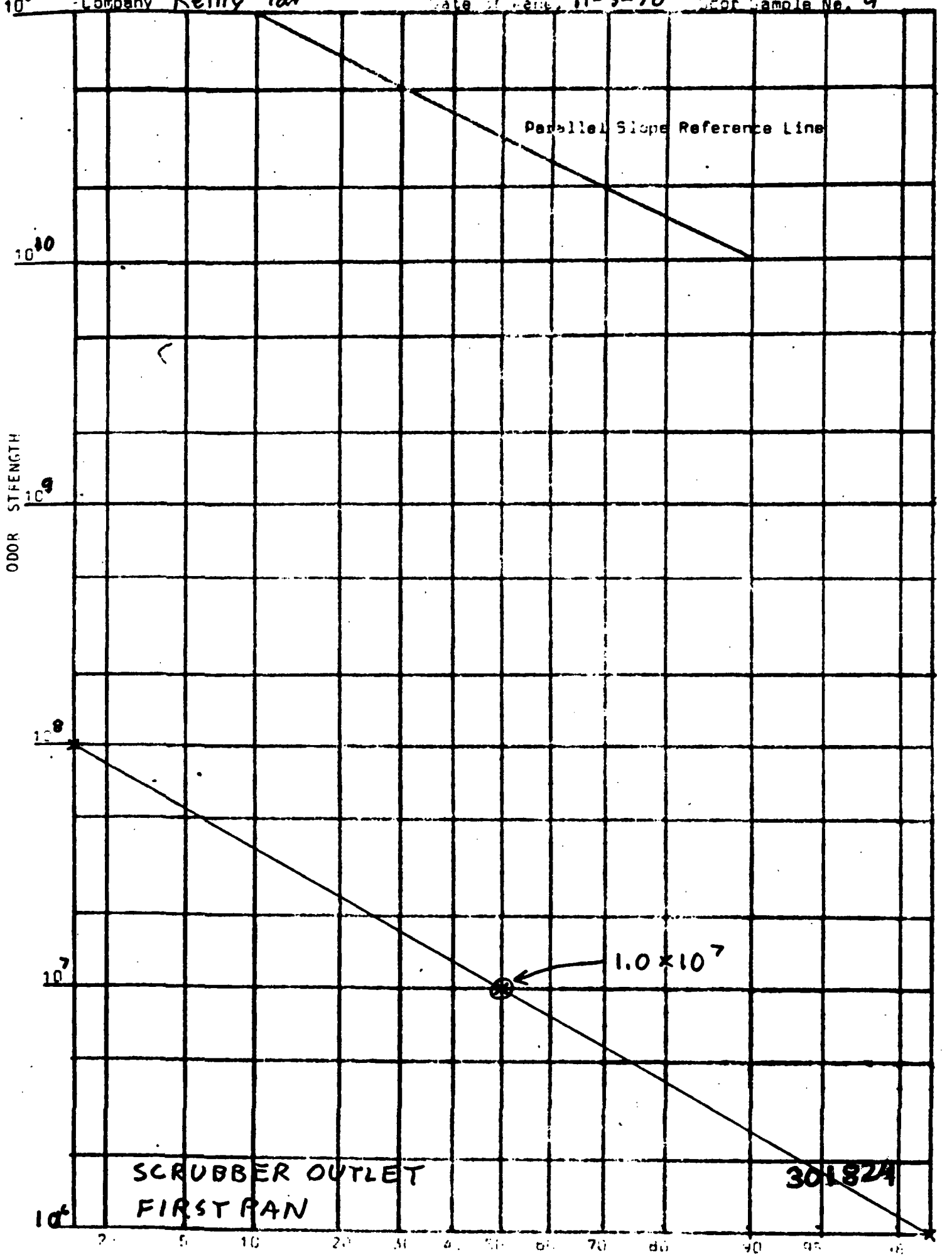
CONDENSER INLET
END OF CYCLE

301823

6-1

POLLUTION CONTROL, INC. ODOR RESPONSE CHART NO. 11-4

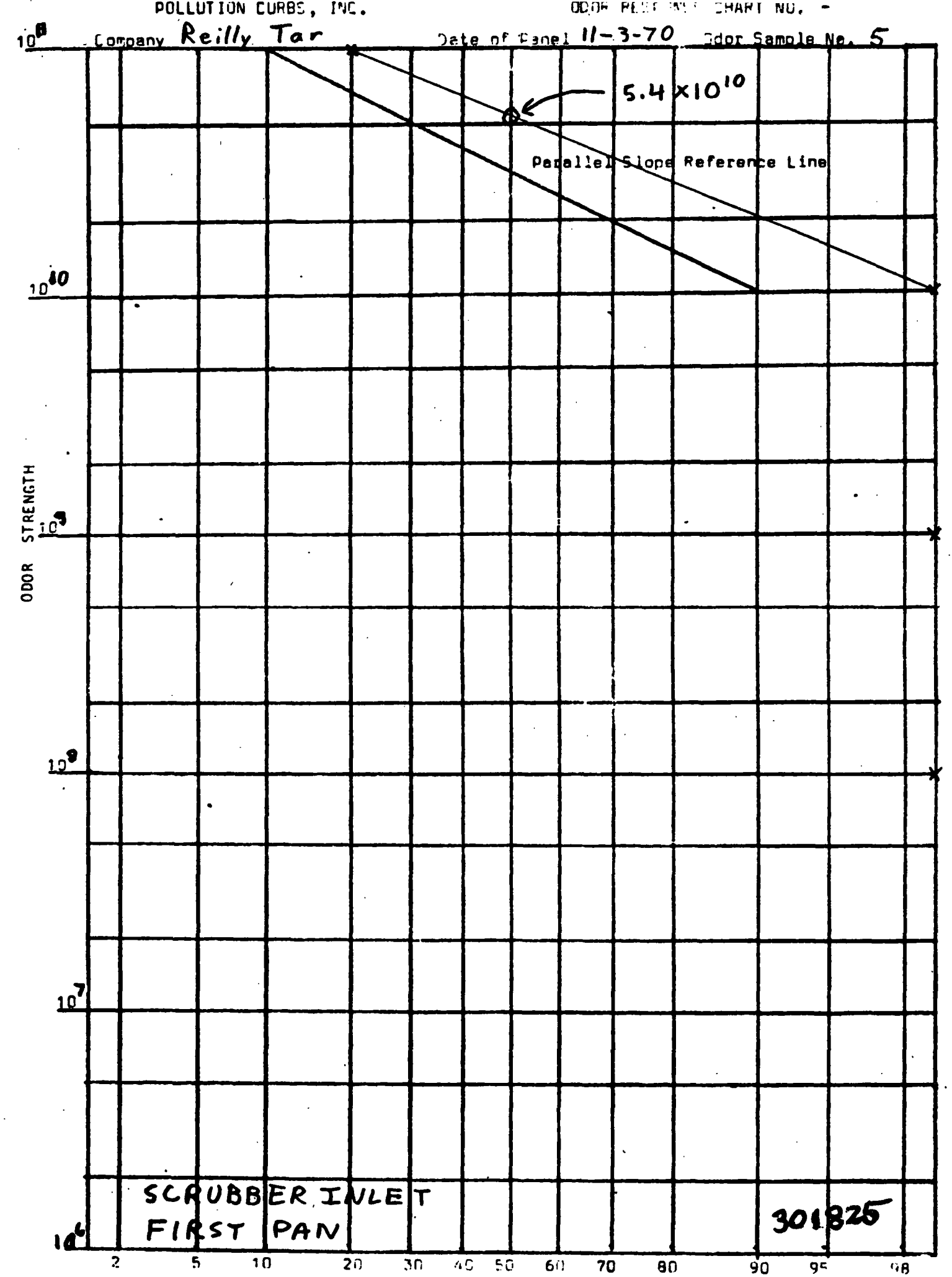
Company Reilly Tar Date of Test 11-3-70 For Sample No. 4



PER CENT OF PANEL VOLUNTEERS FOR STATED DILUTION

POLLUTION CURBS, INC. ODOR PLUME CHART NO. -

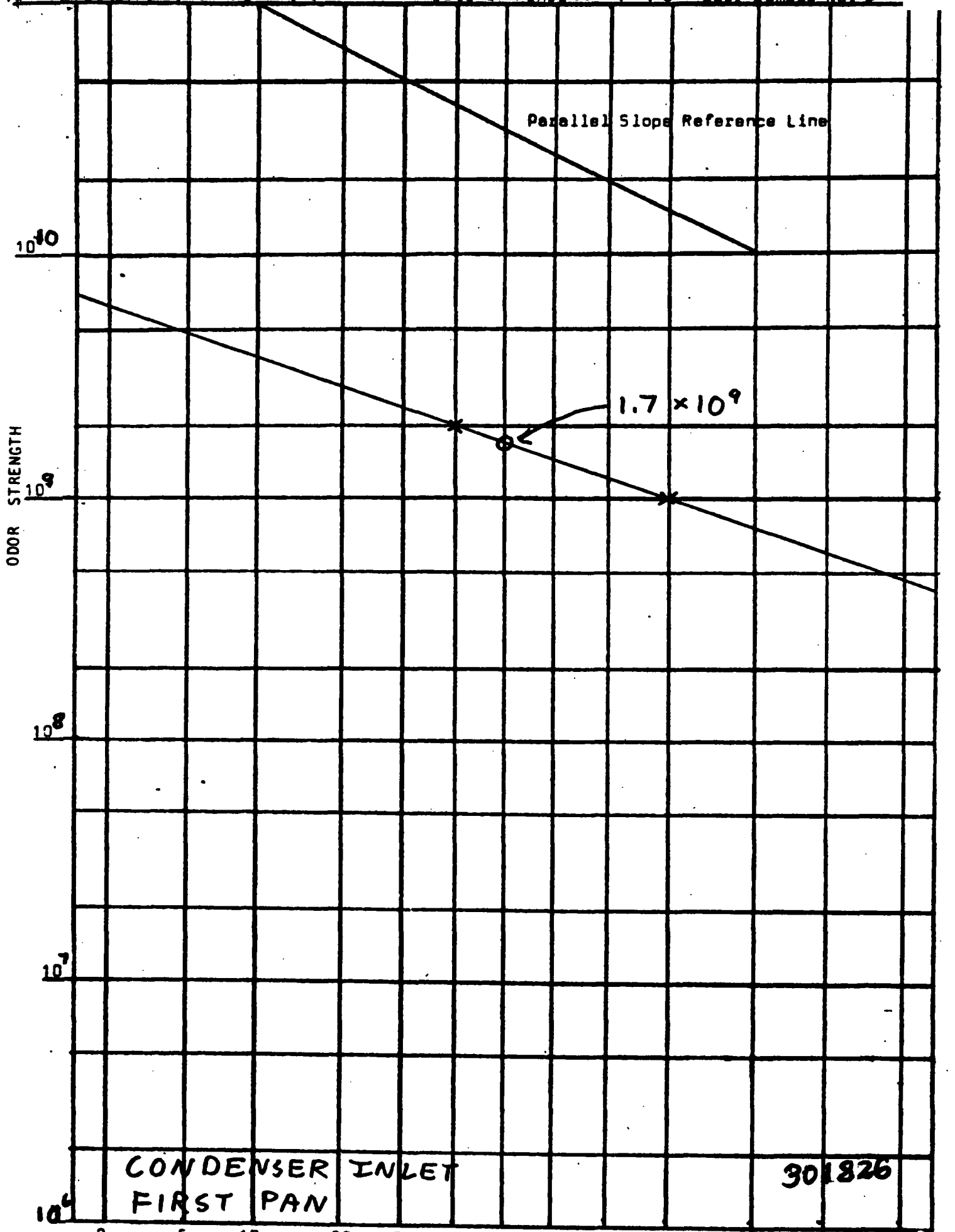
Company Reilly Tar Date of Panel 11-3-70 Odor Sample No. 5



6.8

ODOR RESPONSE CHART NO. 11-6

Company Reilly Tar Date of Panel 11-4-70 Odor Sample No. 2



CONDENSER INLET
FIRST PAN

301826